

**PARTNER PROFILE**

# CIUDEN, Spain: Atmospheric Bubbling Fluidized Bed (ABFB) Gasifier

CIUDEN’s rig based in Cubillos del Sil, Spain consists of a 3 MWth Atmospheric Bubbling Fluidized Bed (ABFB) gasifier based on wood pellets as specified biomass.

Table 1 shows the design biomass parameters. In addition, the installation has been designed to gasify several types of biomass, with the specifications shown in Table 2.

### 1. Biomass Feeding System

The unit is prepared to feed a wide range of biomass from low to high density. To achieve this goal, there are three independent lines, two for treated biomass and the other one for chips. Considering the first case, there is the possibility of simultaneously feeding biomass at both points; the second case is prepared to feed in two different levels (top and bottom of the bed), but not simultaneously.

The feeding system includes the following equipment:

1. Two treated biomass feeding systems:
  - a. Hopper with a loss-in-weight system and a net-volume of three hours of operation.
  - b. Pressurized rotative valve.
  - c. Feed screw.

2. Chip biomass feeding system:
  - a. Hopper with a loss-in-weight system and a real volume of three hours of operation.
  - b. Pressurized rotative valve.
  - c. Two feed screws located at different levels.

### 2. Inert Feeding System

The installation has a sand feeding system capable of continuously feeding the required inert for a high ash biomass operation. An additive feeding system has been installed in order to test the reduction of tar content in the gas.

### 3. Start-up System

The start-up system is an internal refractory lined

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Table 1: Design biomass parameters.

	Design biomass: Wood pellets		
	As received	Dry basis	Dry ash-free basis
LHV (MJ/kg)	17.08	18.39	18.52
HHV (MJ/kg)	18.42	19.65	19.798
C (% w)	-	49.47	49.80
H (% w)	-	5.79	5.83
N (% w)	-	2.03	2.04
S (% w)	-	0.06	0.60
O (% w)	-	41.94	42.22
Moisture (% w)	6.28	-	-
Ash (% w)	0.67	0.71	-
Volatiles (% w)	75.89	80.98	81.56
Fixed C (% w)	17.16	18.31	18.44



Figure 1: CIUDEN’s biomass feeding system.

Table 2: CIUDEN’s ABFB installation has been designed to gasify several types of biomass: the process specifications are summarised below.

Characteristic	Engineering Unit	Treated biomass	Chips
		Required value	Required value
LHV	kcal/kg	> 3500	> 3500
Density	kg/m <sup>3</sup>	> 500	> 250
Size	mm	< 20	< 20
Moisture	%	< 20	< 20
Ash	%	< 10	< 10

**PARTNER PROFILE**

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Figure 2: Inert feeding system.



Figure 4: Gasification island.



Figure 3: Start-up system.



Figure 5: Gas cleaning system.

combustion chamber that uses natural gas as fuel. The hot flue gases generated during the combustion process will be sent to the gasifier in order to achieve the required thermal load to start-up the unit.

#### 4. Gasification Island

##### *Forced-draft fan*

This equipment has to supply the quantity of required air to fluidize the bed during the conventional gasification process and to supply the required pressure to vent flue gases out of the gasifier.

##### *Gasifier*

The gasifier is an internal refractory lined 1.3m internal diameter bed bubbling fluidized bed reactor. The freeboard is a 2.0m internal diameter and the reactor is a 5.5m in total height. The unit incorporates two internal refractory lined high efficiency cyclones.

The gasifier is fully instrumented with an array of thermocouples (19), differential pressure transmitters (6) and four reserved ports to

*Continued on next page*

## PARTNER PROFILE

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complete the tests, with sample connections in the bed area.

### 5. Gas Cleaning System

CIUDEN's rig includes two internal refractory lined high efficiency cyclones whose main goal is to eliminate the majority of fly ashes and inert gas that could have been elutriated from the bed.

In the short term, CIUDEN is going to study the possibility of installing a wet gas cleaning system in order to treat the produced syngas.

### 6. Ash Removal System

The unit has two independent ash removal systems in order to collect the bottom and fly ashes generated.

### 7. Capabilities of the rig for data acquisition

The unit is fully instrumented with advanced PLC control, temperature, pressure and pressure drop measurement. A Tuneable Diode Laser (TDL) is responsible for the supervision of oxygen content of the gas, and the gas content analysis is performed with an on-line gas chromatograph (H<sub>2</sub>, CO<sub>2</sub>, CO, O<sub>2</sub> and CH<sub>4</sub>). There are dedicated sampling connections in the gas duct to complete the test with extractive analysis.

### 8. Flare and stack

Due to the fact that the obtained syngas is not used in other points of the installation, CIUDEN's rig incorporates a flare in order to finish the combustion process of the gases.



Figure 6: CIUDEN's flare and stack.

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